Case Study: North Dakota

Using FAF Data in Economic Analysis

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NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

Agenda

- Background
- Objective of the case study
- Economic analysis and FAF
- Understanding FAF
- Why FAF?
- Incorporating FAF
- Results
- Q & A

Background

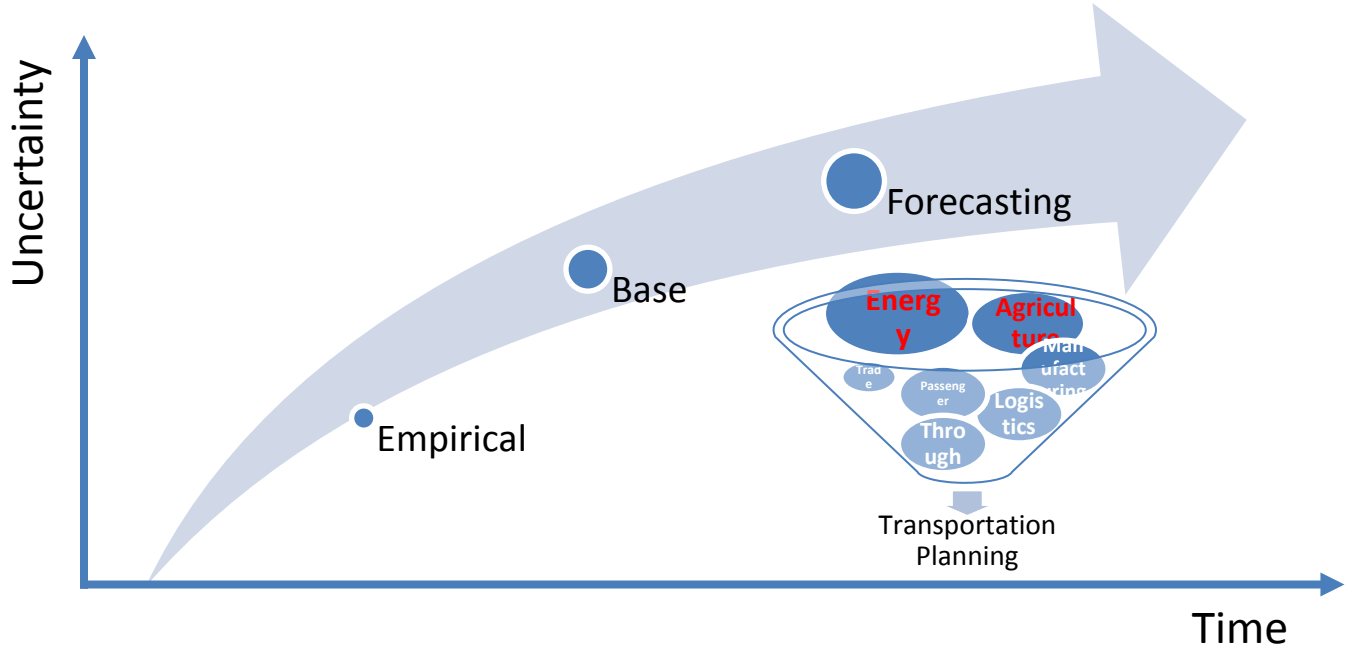
- Boom of oil & gas industries, changes of agricultural logistics pattern, and increase of other baseline traffic
- Road infrastructure needs for a 20-year planning horizon
- Needs for travel demand modeling (TDM) and economic analysis

Objective of the Case Study

- To support NDDOT and Counties to identify current and future needs
- Tasks
  - To quantify freight flows for commodities on major highways and local roads
  - To forecast future highway capacity
  - To estimate investments needs

Needs for Statewide Modeling

- Funnel of Dynamic Economic Activities
  - Increasing complexity

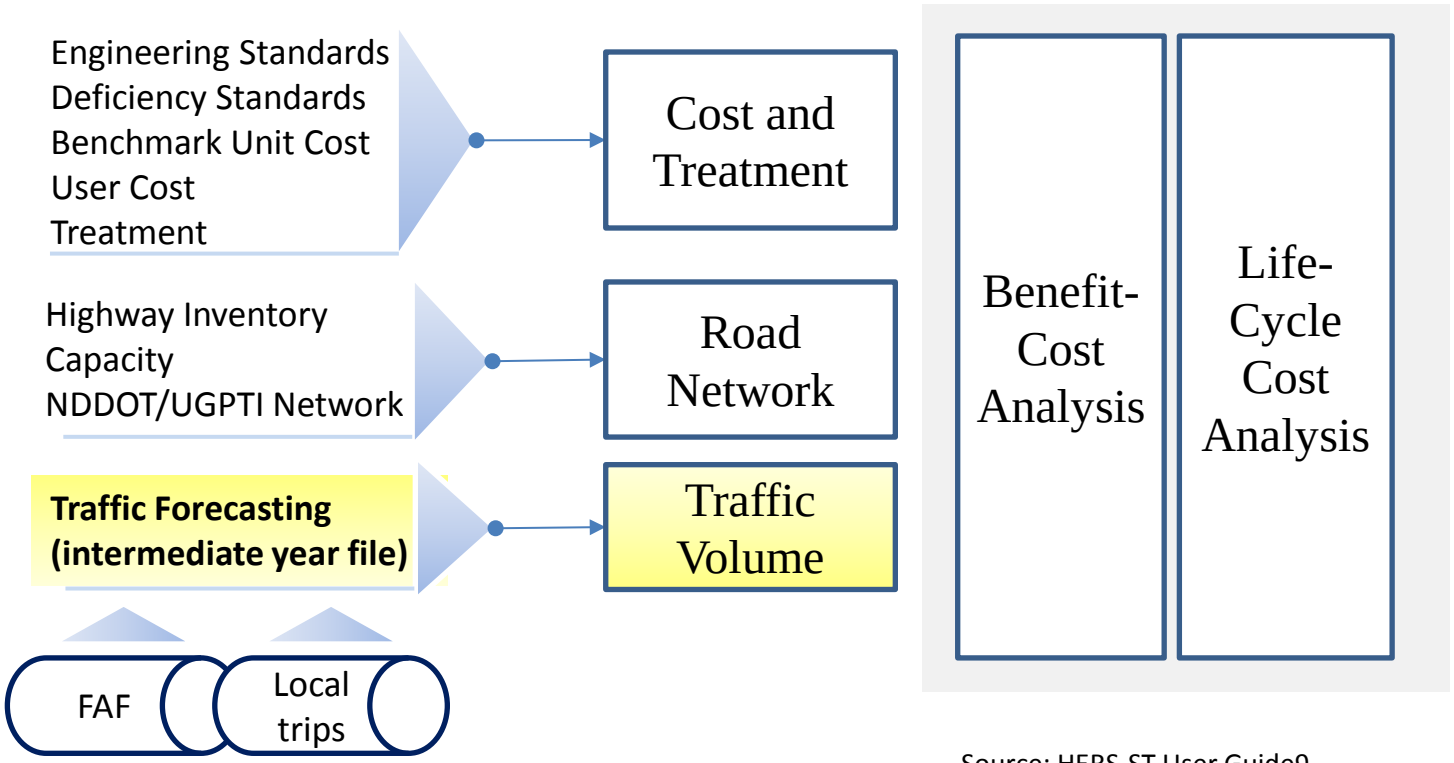


Importance of Economic Analysis

- Critical rural freight corridors for goods movement
- Financial constraint
- Deteriorated and insufficient infrastructure for energy and agricultural logistics and economic activities
- Using FAF Traffic Data
  - Benefit Cost Analysis (BCA)
  - Life-Cycle Cost Analysis (LCCA)

Economic Analysis Process

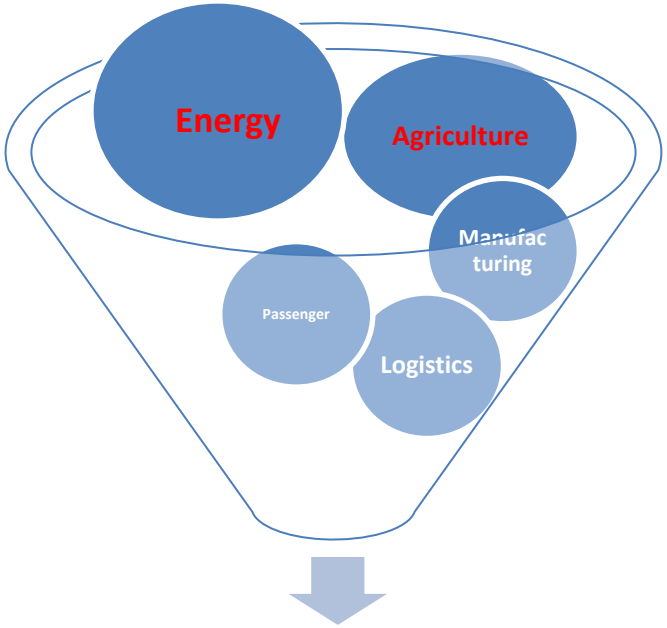
Overview

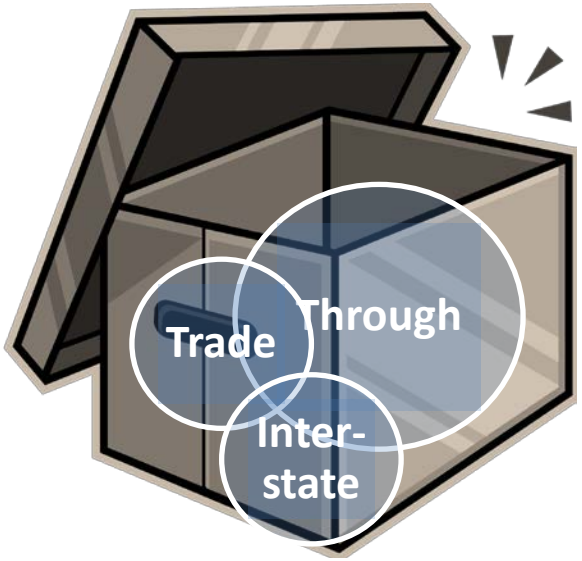


Source: HERS-ST User Guide9

State Traffic Model

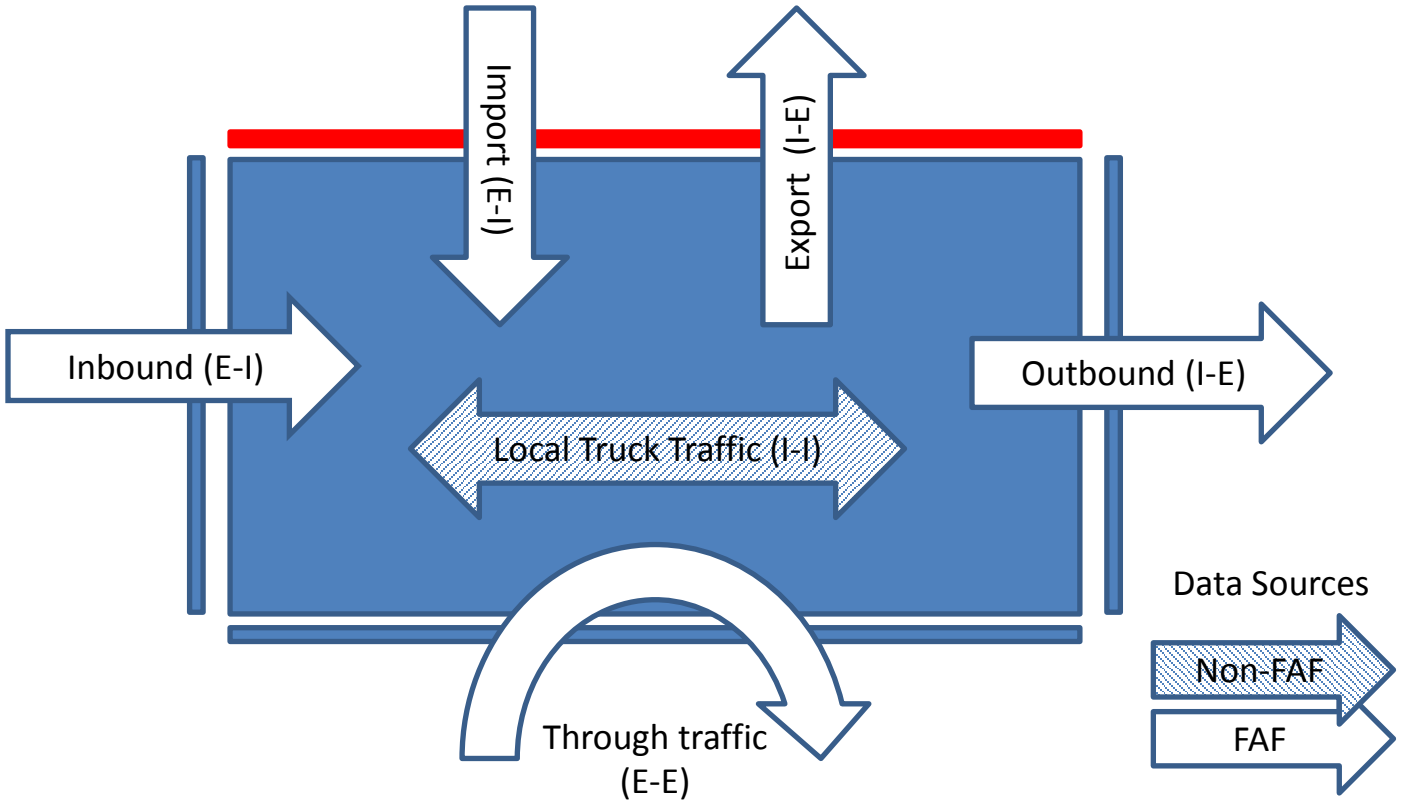
- Intra-zonal Movement
  - UGPTI Report from www.ugpti.org





Economic Analysis Tools

Traffic Flow in FAF



What FAF does and does NOT do

- What the FAF does
  - Indicates states' and localities' major trading partners, plus volumes and sources of traffic passing through their jurisdictions at **corridor level**
  - Shows truck **tonnage and number of trucks** on the network, particularly in regions with multiple routes or significant local traffic between major centers of freight activity
- What the FAF does NOT
  - Show local detail or temporal variation in freight flows
  - **Provide local data to support local applications**

Things To know About FAF3

- Geographic regions
  - Single TAZ in North Dakota
- Network
  - Centerline without considering directions for divided highways and one-way traffic
  - Not designed for the purpose of routing
  - Primary freight network and critical rural freight corridors (no local roads)
- Attributes
  - No road condition / No pavement type
- Adjustment
  - Coarse space and time

Things To know About FAF3

- Geographic regions (FAF Zone)

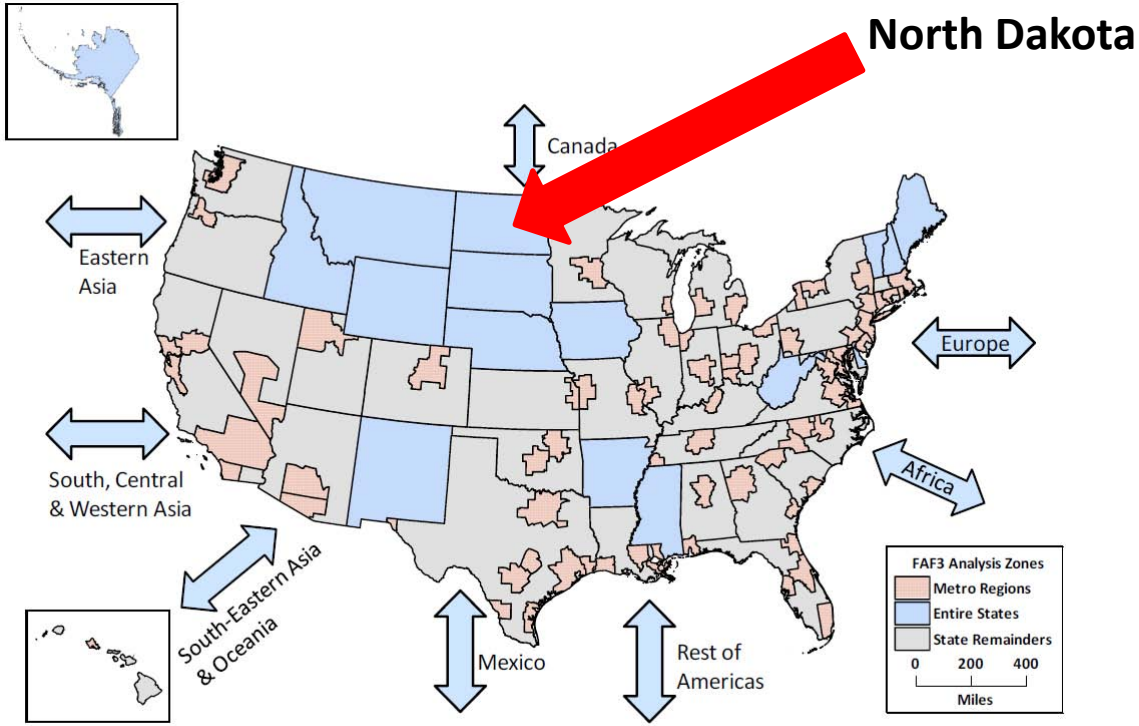
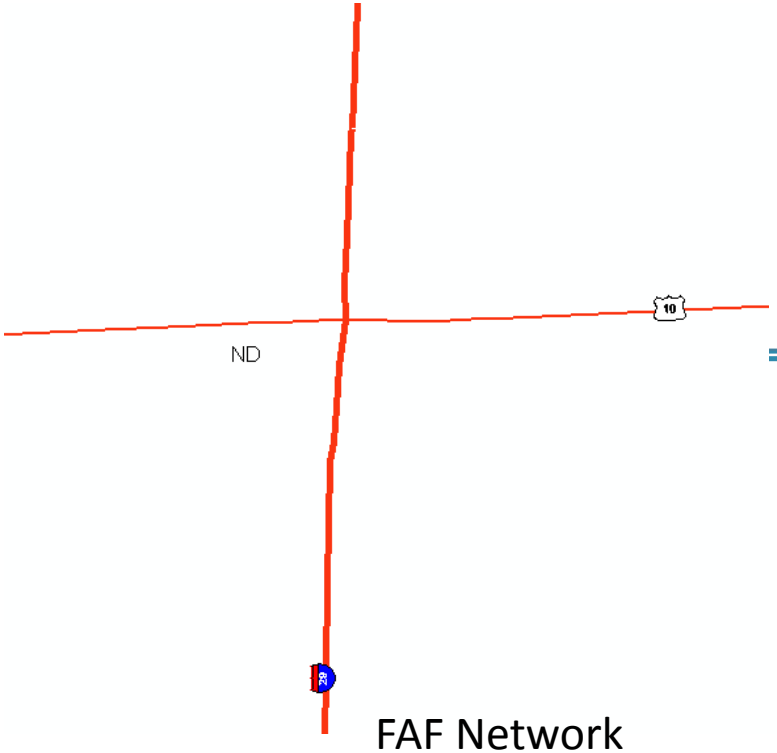


Figure 2.1 FAF^3 Geography

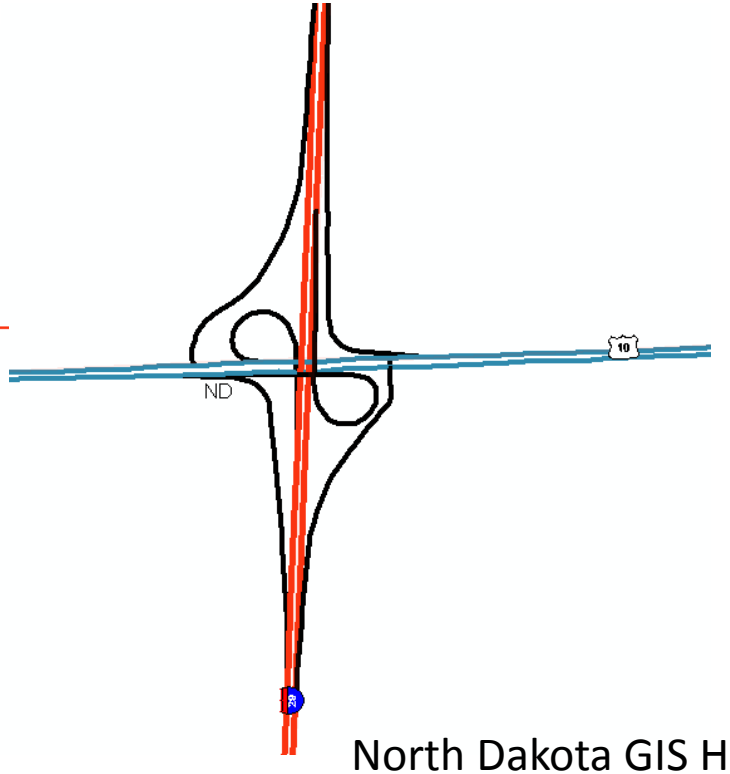
Source: http://faf.ornl.gov/fafweb/Documentation.aspx

Things To know About FAF3

- Comparison of FAF and state networks



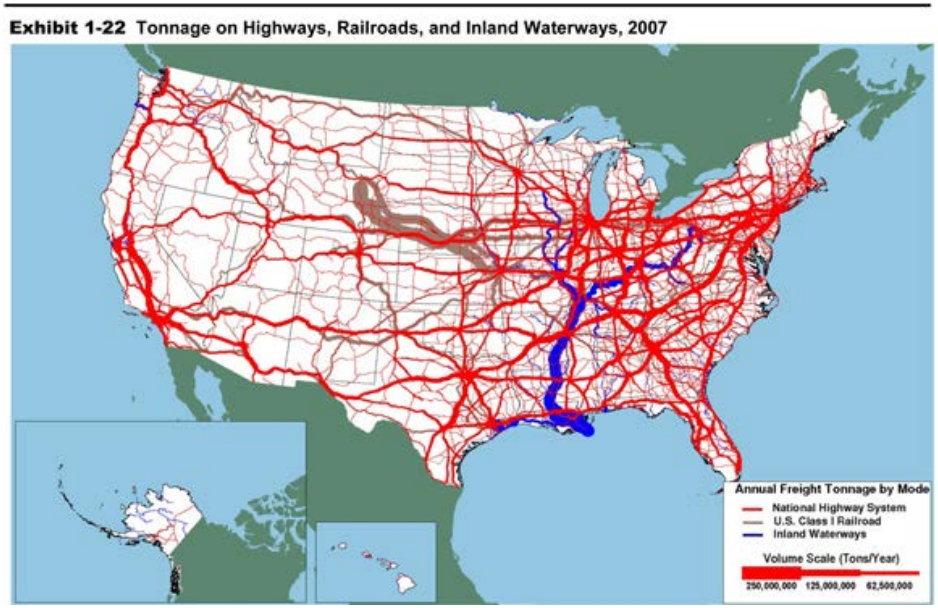
FAF Network



North Dakota GIS Hub

Why FAF?

- Comprehensive freight movements
- Multimodal infrastructure
- Authoritative
- Affordable
- Easy to use



Freight Analysis Framework Data Tabulation Tool

- **Freight Analysis Framework Version 3**
  - Overview
  - Version Descriptions
  - Summary Statistics
  - Data Tabulation Tool
  - FAF^3 Maps
  - Network Database and Flow Assignment
  - Documentation
- **Related Links**
  - Freight Analysis Framework home
  - FHWA Office of Freight Management and Operations home
  - Freight at U.S. DOT
  - CTA/ORNL

Total Flows Domestic Flows Import Flows Export Flows

This option is provided for users interested in tabulating FAF^3 data to examine total flows moved between domestic origins and destinations and includes both domestic and foreign shipments. For import shipments, the origin of the flow is the zone (state or region) of entry, and for export shipments the destination of the flow is the zone (state or region) of exit. Mode of transportation for this tabulation is the mode used from zone of entry to the domestic destination, domestic origin to domestic destination, and domestic origin to zone of exit.

Note: The units of measure for 1997, 2002, 2007, and 2015-2040 data are **thousands of tons** for weight, **millions of 2007 dollars** for value, and millions for ton-miles. Provisional Annual Data for the most recent year are presented in both millions of 2007 dollars and millions of current dollars (Current M$).

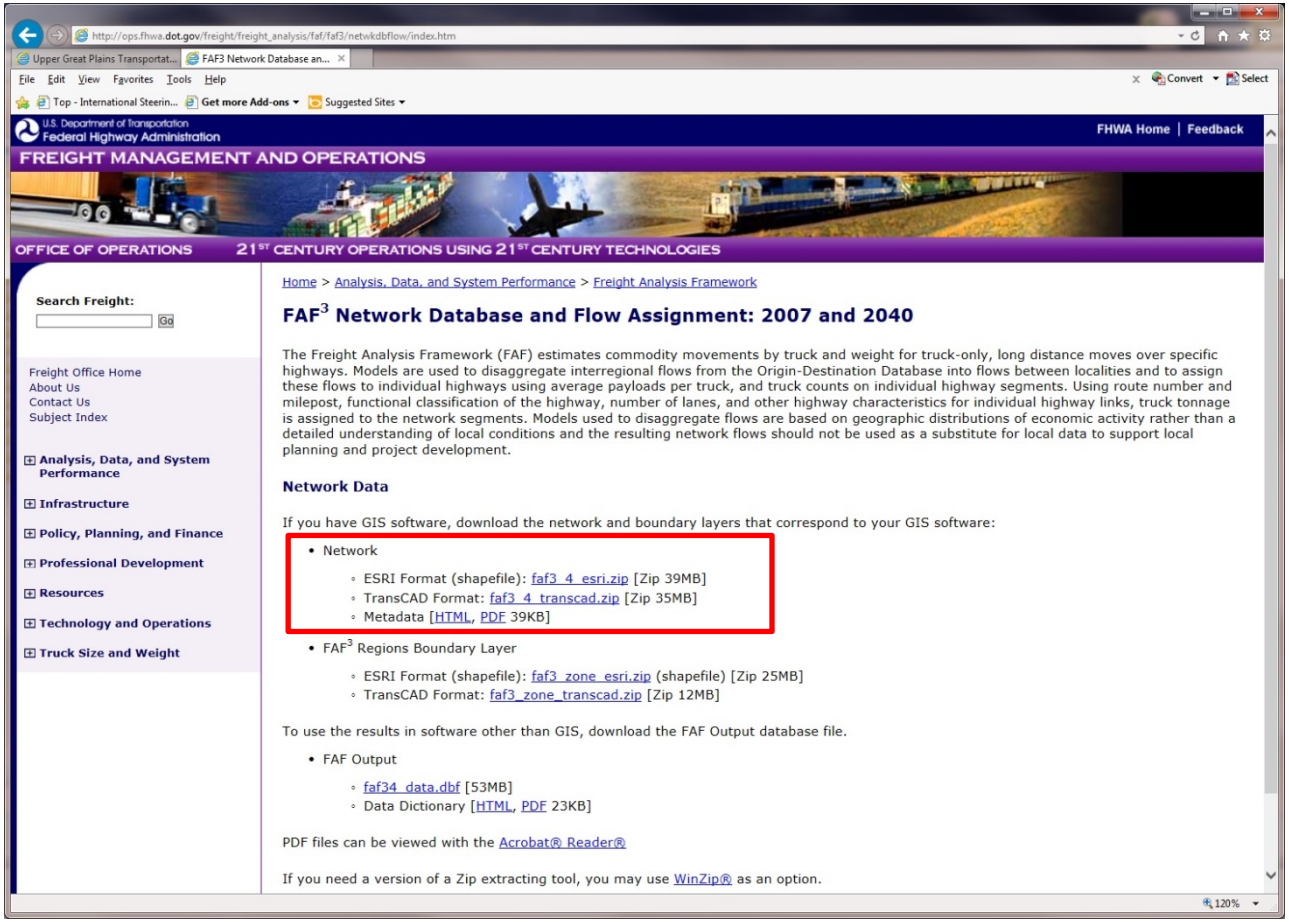
Year	Origin	Destination
1997 2002 2007 2012 2015 2020 2025	Origin state-specific info New Hampshire New Jersey New Mexico New York North Carolina North Dakota	Destination FAF zone-specific info Select all FAF zones Birmingham AL CSA Mobile AL CSA Remainder of Alabama Alaska Phoenix AZ MSA

Measure	Commodity	Domestic Mode
Select All Tons Ton-Mile Values	10 Building stone 11 Natural sands 12 Gravel 13 Nonmetallic minerals 14 Metallic ores 15 Coal 16 Crude petroleum	Combine total (no specific info) Select all 1 Truck 2 Rail 3 Water 4 Air (include truck-air) 5 Multiple modes & mail

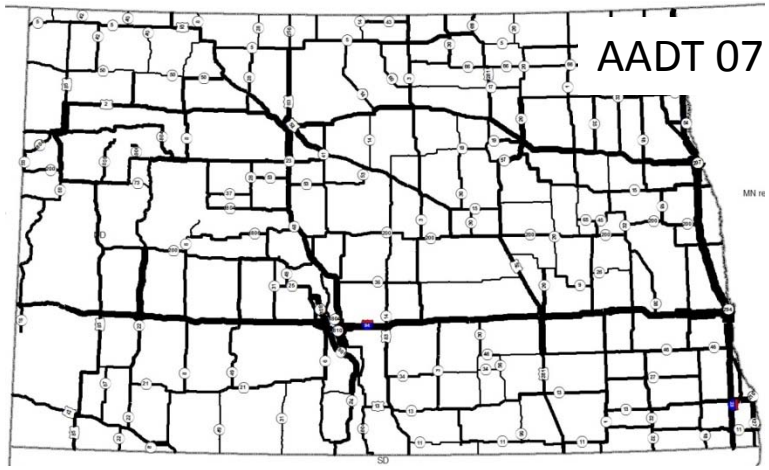
Clear Results >>Download Results as a CSV file Submit

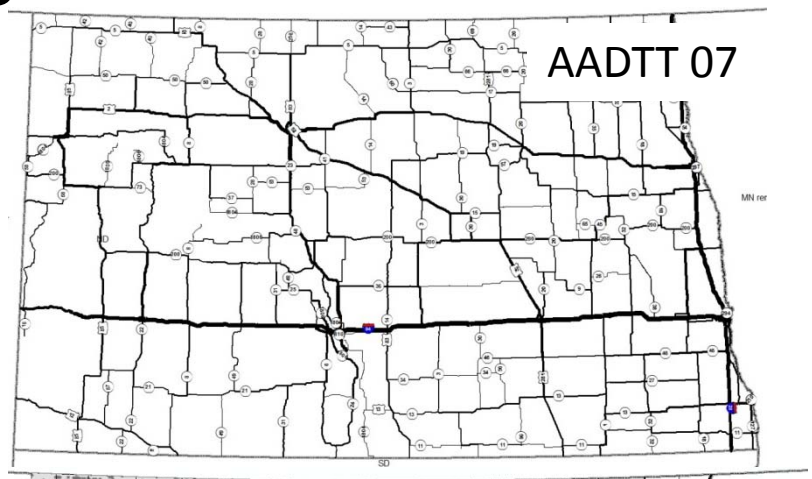
DMS ORIG	DMS_DEST	SCTG2	DMS_MODE	Total KTons in 2012
North Dakota	Denver CO CSA	Crude petroleum	Truck	10.81
North Dakota	Chicago IL-IN-WI CSA (IL Part)	Crude petroleum	Truck	0.00
North Dakota	Iowa	Crude petroleum	Truck	0.00
North Dakota	Remainder of Kansas	Crude petroleum	Truck	4.37
North Dakota	Minneapolis-St. Paul MN-WI CSA (MN Part)	Crude petroleum	Truck	10.23
North Dakota	Remainder of Minnesota	Crude petroleum	Truck	0.00
North Dakota	Montana	Crude petroleum	Truck	56.73
North Dakota	Nebraska	Crude petroleum	Truck	0.00
North Dakota	North Dakota	Crude petroleum	Truck	17.96
North Dakota	South Dakota	Crude petroleum	Truck	0.00
North Dakota	Remainder of Wisconsin	Crude petroleum	Truck	1.14
North Dakota	Wyoming	Crude petroleum	Truck	63.04

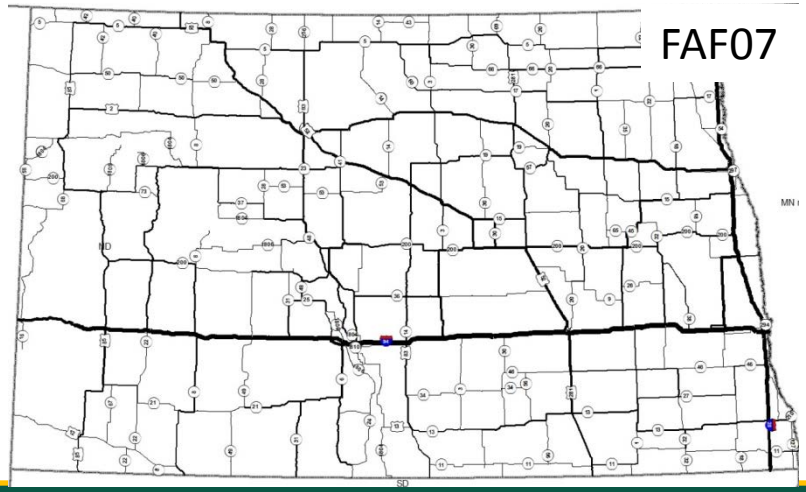
Data Download

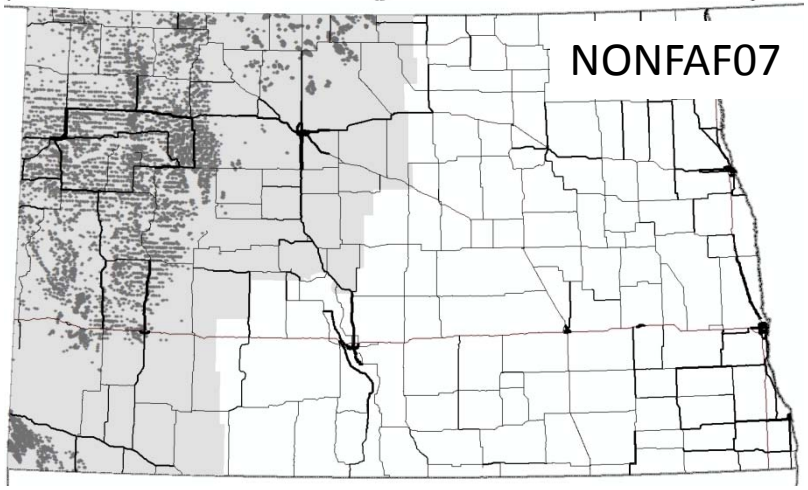


FAF Freight: 2007

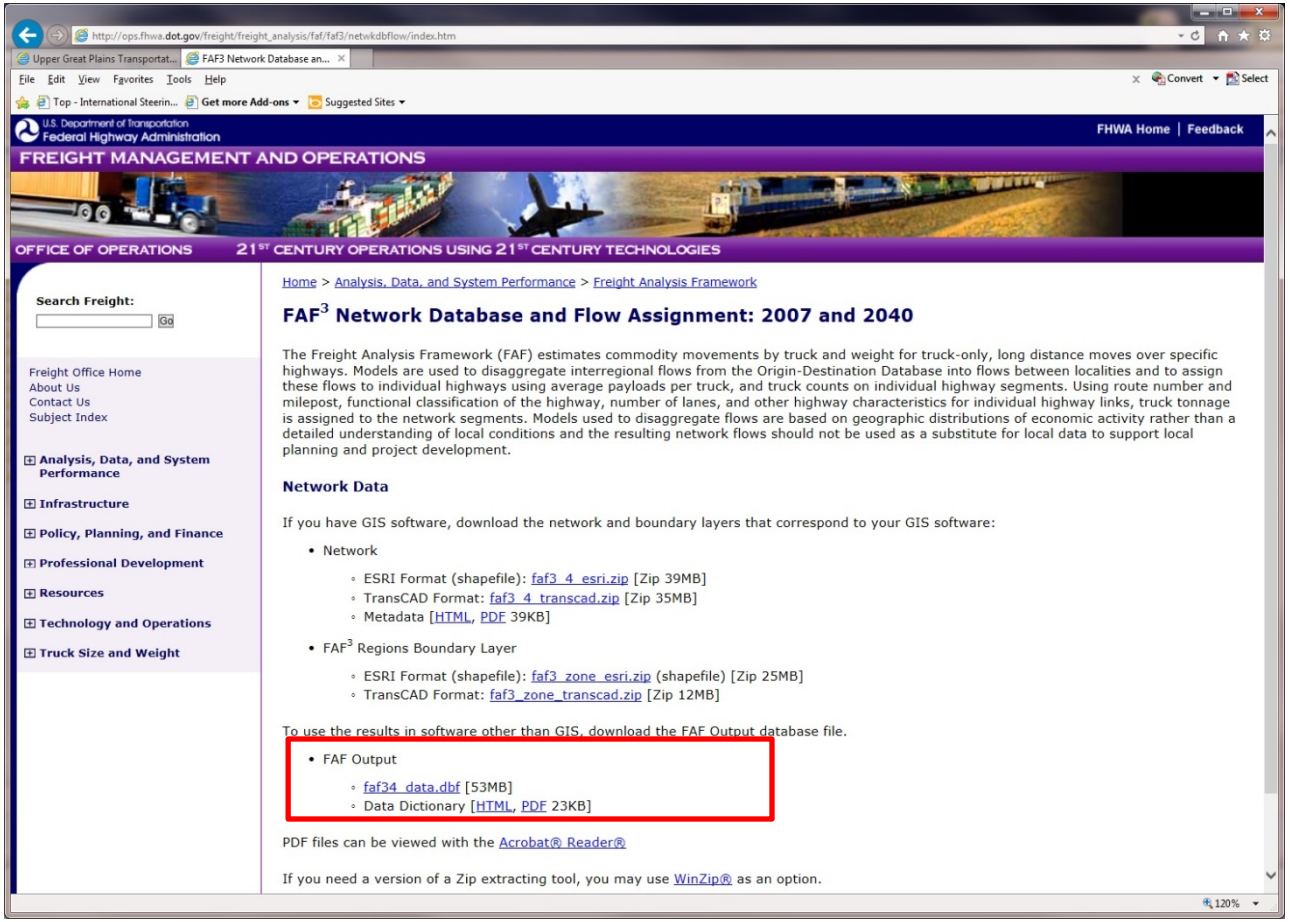




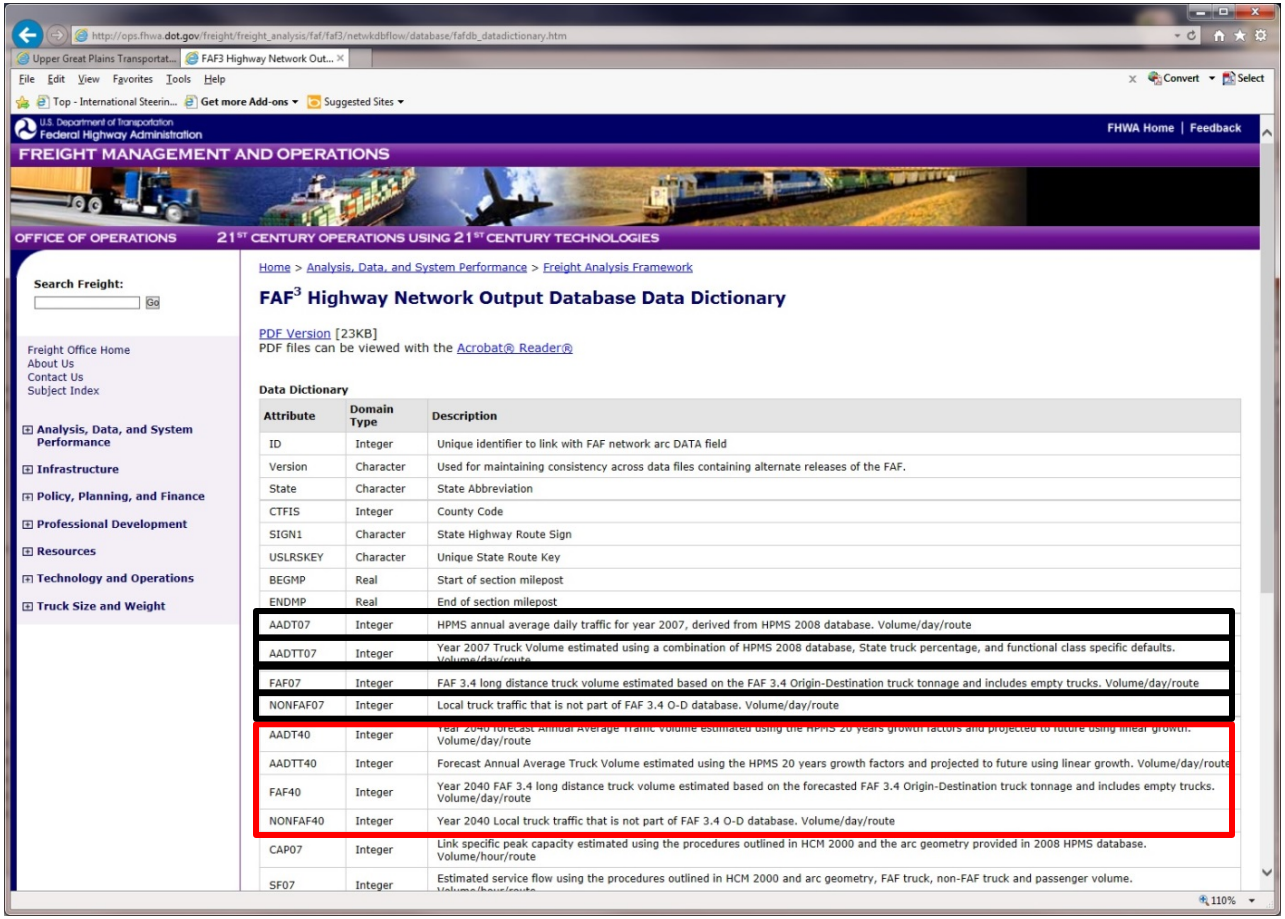




Data Download



FAF – Data Dictionary



U.S. Department of Transportation
Federal Highway Administration

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- Truck Size and Weight

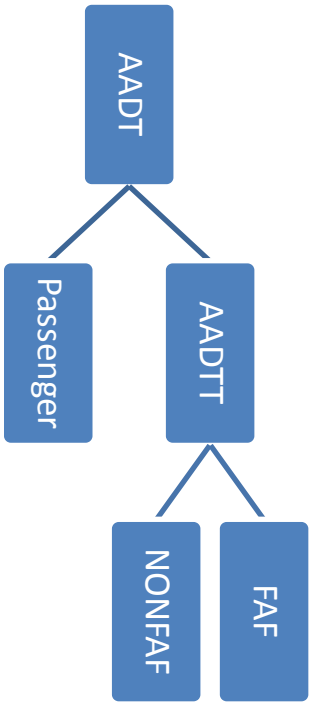
Home > Analysis, Data, and System Performance > Freight Analysis Framework

FAF^3 Highway Network Output Database Data Dictionary

PDF Version [23KB]
PDF files can be viewed with the Acrobat® Reader®

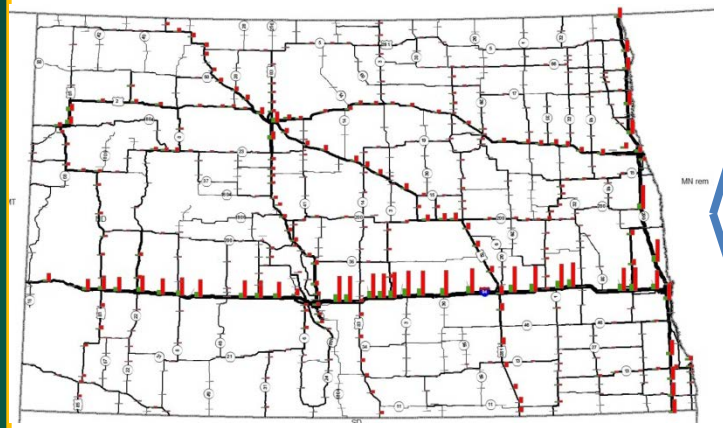
Data Dictionary

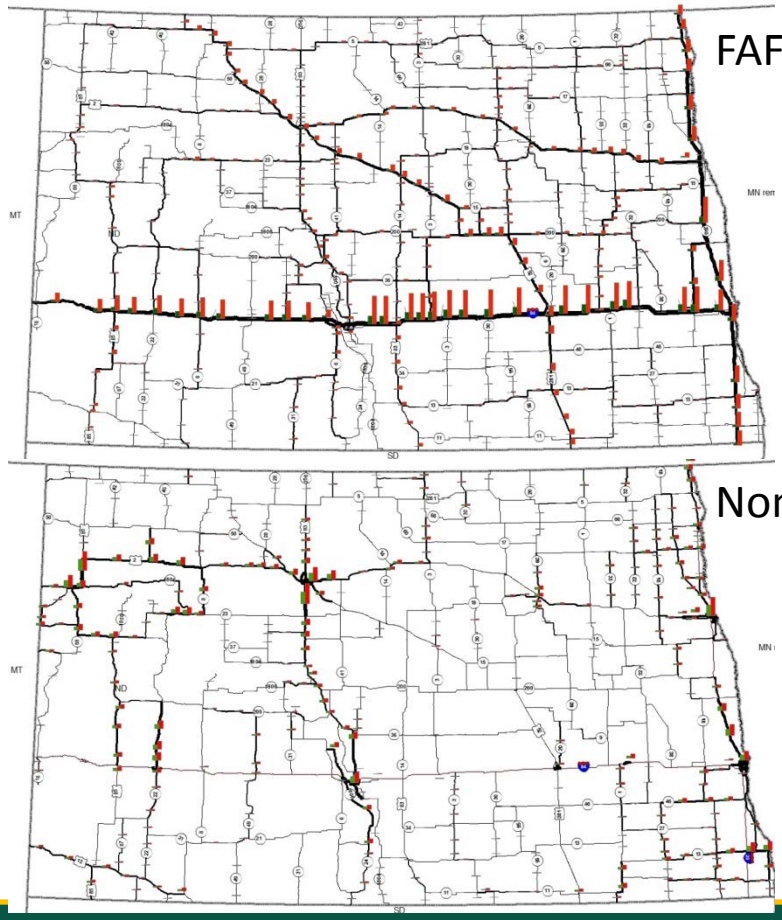
Attribute	Domain Type	Description
ID	Integer	Unique identifier to link with FAF network arc DATA field
Version	Character	Used for maintaining consistency across data files containing alternate releases of the FAF.
State	Character	State Abbreviation
CTFIS	Integer	County Code
SIGN1	Character	State Highway Route Sign
USLRSKEY	Character	Unique State Route Key
BEGMP	Real	Start of section milepost
ENDMP	Real	End of section milepost
AADT07	Integer	HPMS annual average daily traffic for year 2007, derived from HPMS 2008 database. Volume/day/route
AADTT07	Integer	Year 2007 Truck Volume estimated using a combination of HPMS 2008 database, State truck percentage, and functional class specific defaults. Volume/day/route
FAF07	Integer	FAF 3.4 long distance truck volume estimated based on the FAF 3.4 Origin-Destination truck tonnage and includes empty trucks. Volume/day/route
NONFAF07	Integer	Local truck traffic that is not part of FAF 3.4 O-D database. Volume/day/route
AADT40	Integer	Year 2040 forecast Annual Average Traffic Volume estimated using the HPMS 20 years growth factors and projected to future using linear growth. Volume/day/route
AADTT40	Integer	Forecast Annual Average Truck Volume estimated using the HPMS 20 years growth factors and projected to future using linear growth. Volume/day/route
FAF40	Integer	Year 2040 FAF 3.4 long distance truck volume estimated based on the forecasted FAF 3.4 Origin-Destination truck tonnage and includes empty trucks. Volume/day/route
NONFAF40	Integer	Year 2040 Local truck traffic that is not part of FAF 3.4 O-D database. Volume/day/route
CAP07	Integer	Link specific peak capacity estimated using the procedures outlined in HCM 2000 and the arc geometry provided in 2008 HPMS database. Volume/hour/route
SF07	Integer	Estimated service flow using the procedures outlined in HCM 2000 and arc geometry, FAF truck, non-FAF truck and passenger volume. Volume/hour/route



FAF3.4 Freight: Growth

AADTT
(Average Annual Daily Truck Traffic)

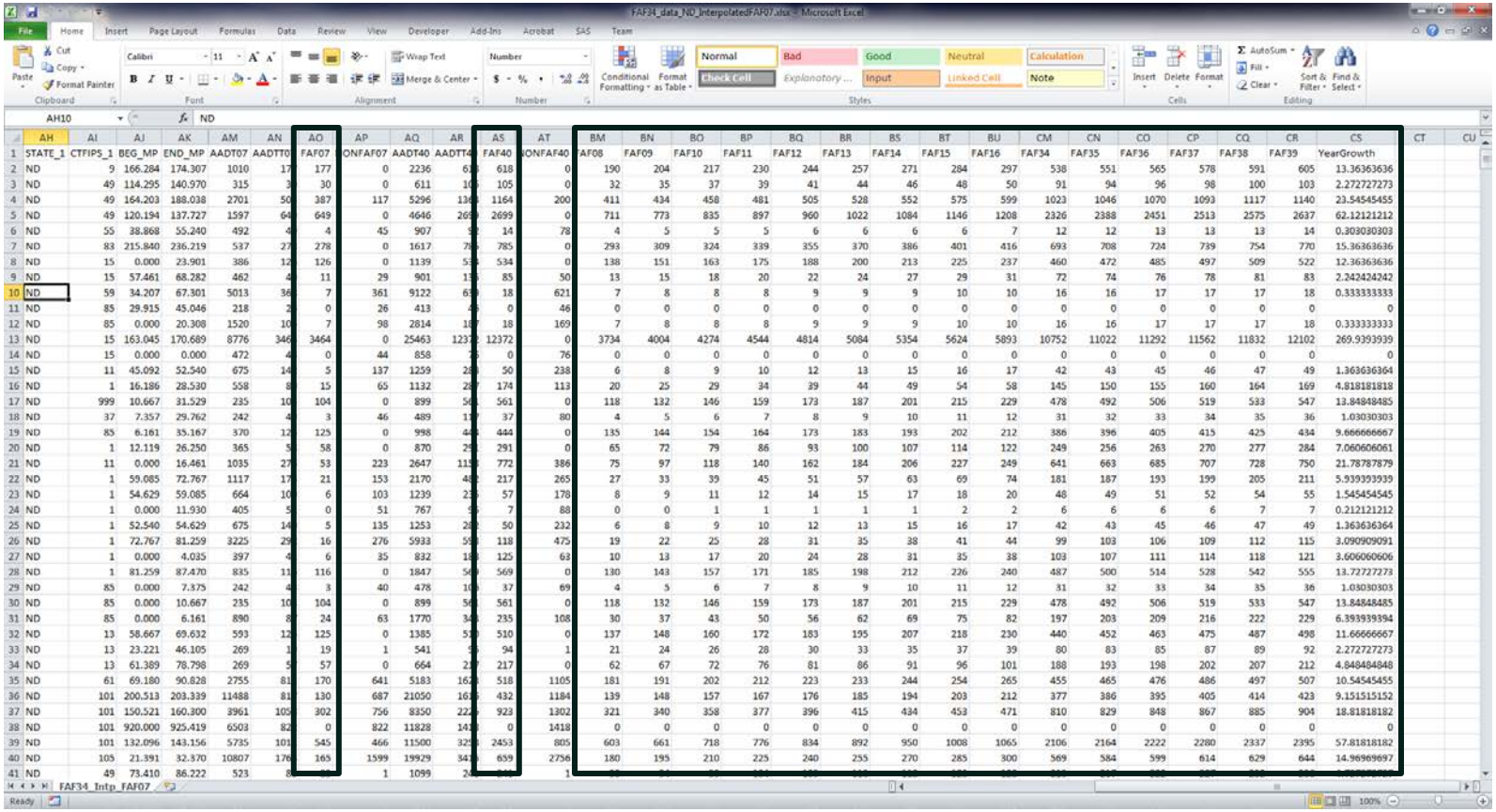




FAF3 - Traffic Growth

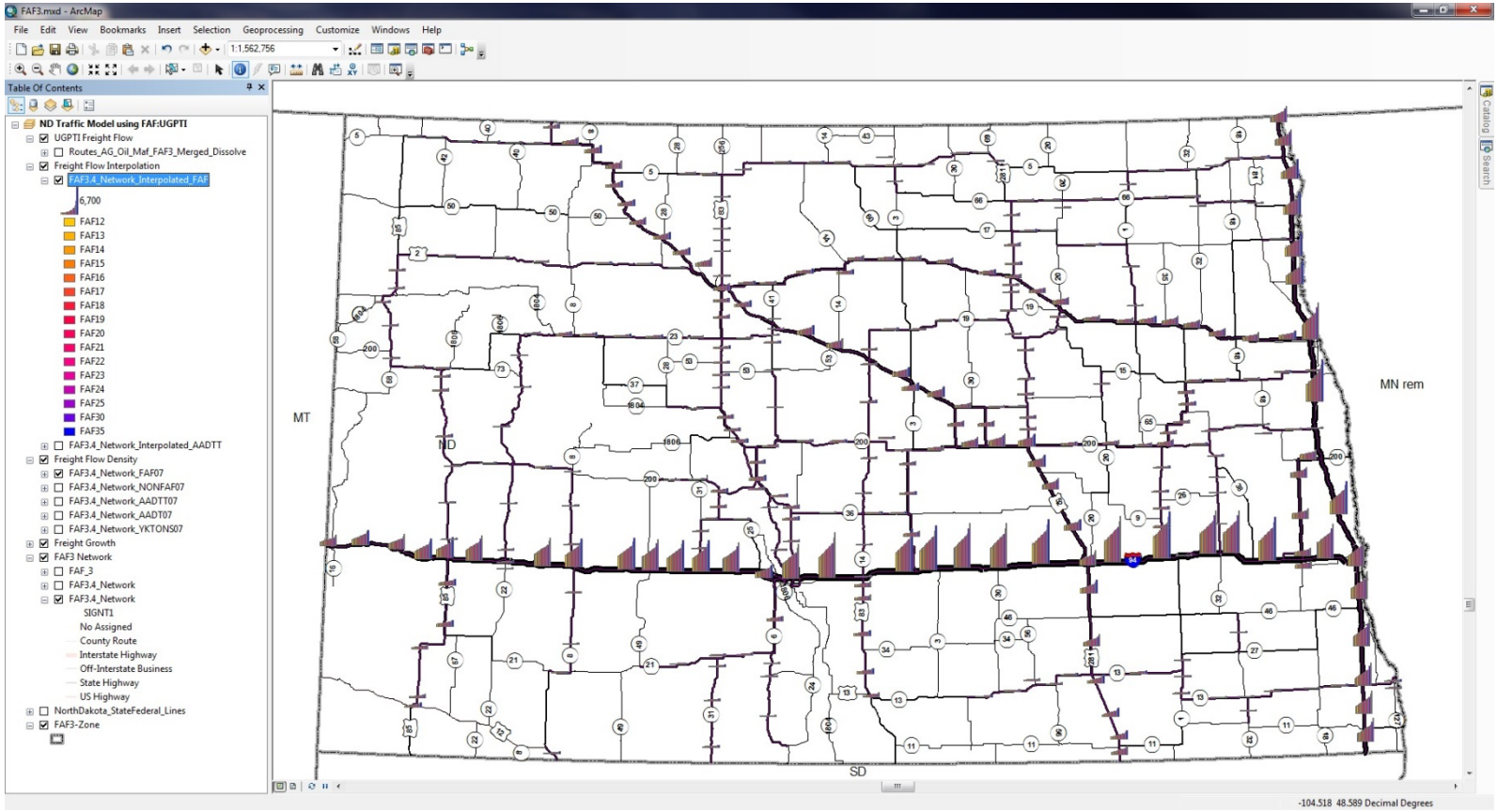
- Missing Annual Traffic Growth
  - FAF07 and
  - ??? **(FAF08, FAF09, …….FAF30, …, FAF39)**
  - FAF40
- Assumption to use FAF traffic for ND Model
  - Using Primal Highways for long distance

Example – Interpolating: FAF



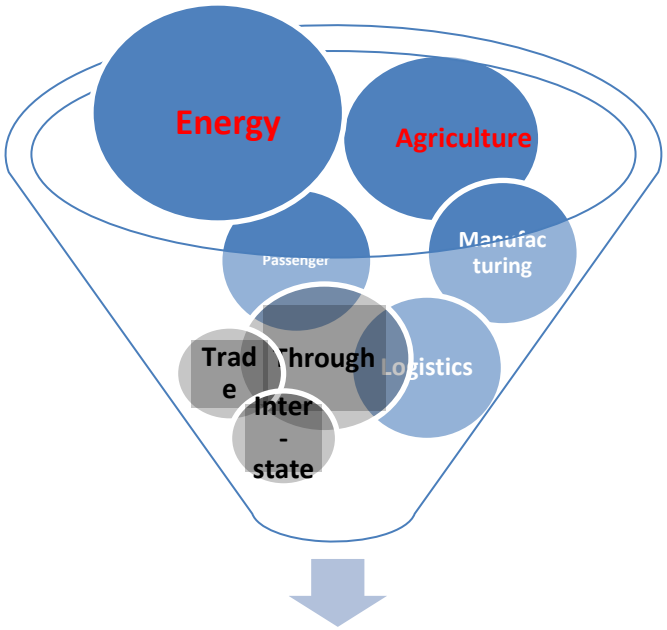
	AH	AI	AJ	AK	AM	AN	AO	AP	AQ	AR	AS	AT	BM	BN	BO	BP	BQ	BR	BS	BT	BU	CM	CN	CO	CP	CQ	CR	CS	CT	CU
1	STATE_1	CTFIPS_1	BEG_MP	END_MP	AADT07	AADTT0	FAF07	ONFAF07	AADT40	AADTT4	FAF40	ONFAF40	FAF08	FAF09	FAF10	FAF11	FAF12	FAF13	FAF14	FAF15	FAF16	FAF34	FAF35	FAF36	FAF37	FAF38	FAF39	YearGrowth		
2	ND	9	166.284	174.307	1010	17	177	0	2236	61	618	0	190	204	217	230	244	257	271	284	297	538	551	565	578	591	605	13.36363636		
3	ND	49	114.295	140.970	315	3	30	0	611	10	105	0	32	35	37	39	41	44	46	48	50	91	94	96	98	100	103	2.272727273		
4	ND	49	164.203	188.038	2701	50	387	117	5296	136	1164	200	411	434	458	481	505	528	552	575	599	1023	1046	1070	1093	1117	1140	23.54545455		
5	ND	49	120.194	137.727	1597	64	649	0	4646	269	2699	0	711	773	835	897	960	1022	1084	1146	1208	2326	2388	2451	2513	2575	2637	62.12121212		
6	ND	55	38.868	55.240	492	4	4	45	907	93	14	78	4	5	5	5	6	6	6	6	7	12	12	13	13	13	14	0.303030303		
7	ND	83	215.840	236.219	537	27	278	0	1617	78	785	0	293	309	324	339	355	370	386	401	416	693	708	724	739	754	770	15.36363636		
8	ND	15	0.000	23.901	386	12	126	0	1139	53	534	0	138	151	163	175	188	200	213	225	237	460	472	485	497	509	522	12.36363636		
9	ND	15	57.461	68.282	462	4	11	29	901	13	85	50	13	15	18	20	22	24	27	29	31	72	74	76	78	81	83	2.242424242		
10	ND	59	34.207	67.301	5013	36	7	361	9122	61	18	621	7	8	8	8	9	9	9	10	10	16	16	17	17	17	18	0.333333333		
11	ND	85	29.915	45.046	218	2	0	26	413	4	0	46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
12	ND	85	0.000	20.308	1520	10	7	98	2814	18	18	169	7	8	8	8	9	9	9	10	10	16	16	17	17	17	18	0.333333333		
13	ND	15	163.045	170.689	8776	346	3464	0	25463	1237	12372	0	3734	4004	4274	4544	4814	5084	5354	5624	5893	10752	11022	11292	11562	11832	12102	269.9393939		
14	ND	15	0.000	0.000	472	4	0	44	858	78	0	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
15	ND	11	45.092	52.540	675	14	5	137	1259	28	50	238	6	8	9	10	12	13	15	16	17	42	43	45	46	47	49	1.363636364		
16	ND	1	16.186	28.530	558	8	15	65	1132	29	174	113	20	25	29	34	39	44	49	54	58	145	150	155	160	164	169	4.818181818		
17	ND	999	10.667	31.529	235	10	104	0	899	56	561	0	118	132	146	159	173	187	201	215	229	478	492	506	519	533	547	13.84848485		
18	ND	37	7.357	29.762	242	4	3	46	489	11	37	80	4	5	6	7	8	9	10	11	12	31	32	33	34	35	36	1.03030303		
19	ND	85	6.161	35.167	370	12	125	0	998	44	444	0	135	144	154	164	173	183	193	202	212	386	396	405	415	425	434	9.666666667		
20	ND	1	12.119	26.250	365	5	58	0	870	29	291	0	65	72	79	86	93	100	107	114	122	249	256	263	270	277	284	7.060606061		
21	ND	11	0.000	16.461	1035	27	53	223	2647	115	772	386	75	97	118	140	162	184	206	227	249	641	663	685	707	728	750	21.78787879		
22	ND	1	59.085	72.767	1117	17	21	153	2170	48	217	265	27	33	39	45	51	57	63	69	74	181	187	193	199	205	211	5.939393939		
23	ND	1	54.629	59.085	664	10	6	103	1239	23	57	178	8	9	11	12	14	15	17	18	20	48	49	51	52	54	55	1.545454545		
24	ND	1	0.000	11.930	405	5	0	51	767	9	7	88	0	0	1	1	1	1	1	2	2	6	6	6	6	7	7	0.212121212		
25	ND	1	52.540	54.629	675	14	5	135	1253	28	50	232	6	8	9	10	12	13	15	16	17	42	43	45	46	47	49	1.363636364		
26	ND	1	72.767	81.259	3225	29	16	276	5933	59	118	475	19	22	25	28	31	35	38	41	44	99	103	106	109	112	115	3.090909091		
27	ND	1	0.000	4.035	397	4	6	35	832	18	125	63	10	13	17	20	24	28	31	35	38	103	107	111	114	118	121	3.606060606		
28	ND	1	81.259	87.470	835	11	116	0	1847	54	569	0	130	143	157	171	185	198	212	226	240	487	500	514	528	542	555	13.72727273		
29	ND	85	0.000	7.375	242	4	3	40	478	10	37	69	4	5	6	7	8	9	10	11	12	31	32	33	34	35	36	1.03030303		
30	ND	85	0.000	10.667	235	10	104	0	899	56	561	0	118	132	146	159	173	187	201	215	229	478	492	506	519	533	547	13.84848485		
31	ND	85	0.000	6.161	890	8	24	63	1770	34	235	108	30	37	43	50	56	62	69	75	82	197	203	209	216	222	229	6.393939394		
32	ND	13	58.667	69.632	593	12	125	0	1385	51	510	0	137	148	160	172	183	195	207	218	230	440	452	463	475	487	498	11.66666667		
33	ND	13	23.221	46.105	269	1	19	1	541	9	94	1	21	24	26	28	30	33	35	37	39	80	83	85	87	89	92	2.272727273		
34	ND	13	61.389	78.798	269	5	57	0	664	21	217	0	62	67	72	76	81	86	91	96	101	188	193	198	202	207	212	4.848484848		
35	ND	61	69.180	90.828	2755	81	170	641	5183	162	518	1105	181	191	202	212	223	233	244	254	265	455	465	476	486	497	507	10.54545455		
36	ND	101	200.513	203.339	11488	81	130	687	21050	161	432	1184	139	148	157	167	176	185	194	203	212	377	386	395	405	414	423	9.151515152		
37	ND	101	150.521	160.300	3961	105	302	756	8350	222	923	1302	321	340	358	377	396	415	434	453	471	810	829	848	867	885	904	18.81818182		
38	ND	101	920.000	925.419	6503	82	0	822	11828	141	0	1418	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
39	ND	101	132.096	143.156	5735	101	545	466	11500	325	2453	805	603	661	718	776	834	892	950	1008	1065	2106	2164	2222	2280	2337	2395	57.81818182		
40	ND	105	21.391	32.370	10807	176	165	1599	19929	341	659	2756	180	195	210	225	240	255	270	285	300	569	584	599	614	629	644	14.96969697		
41	ND	49	73.410	86.222	523	8	1	1099	24	1																				

Example – Interpolated: FAF

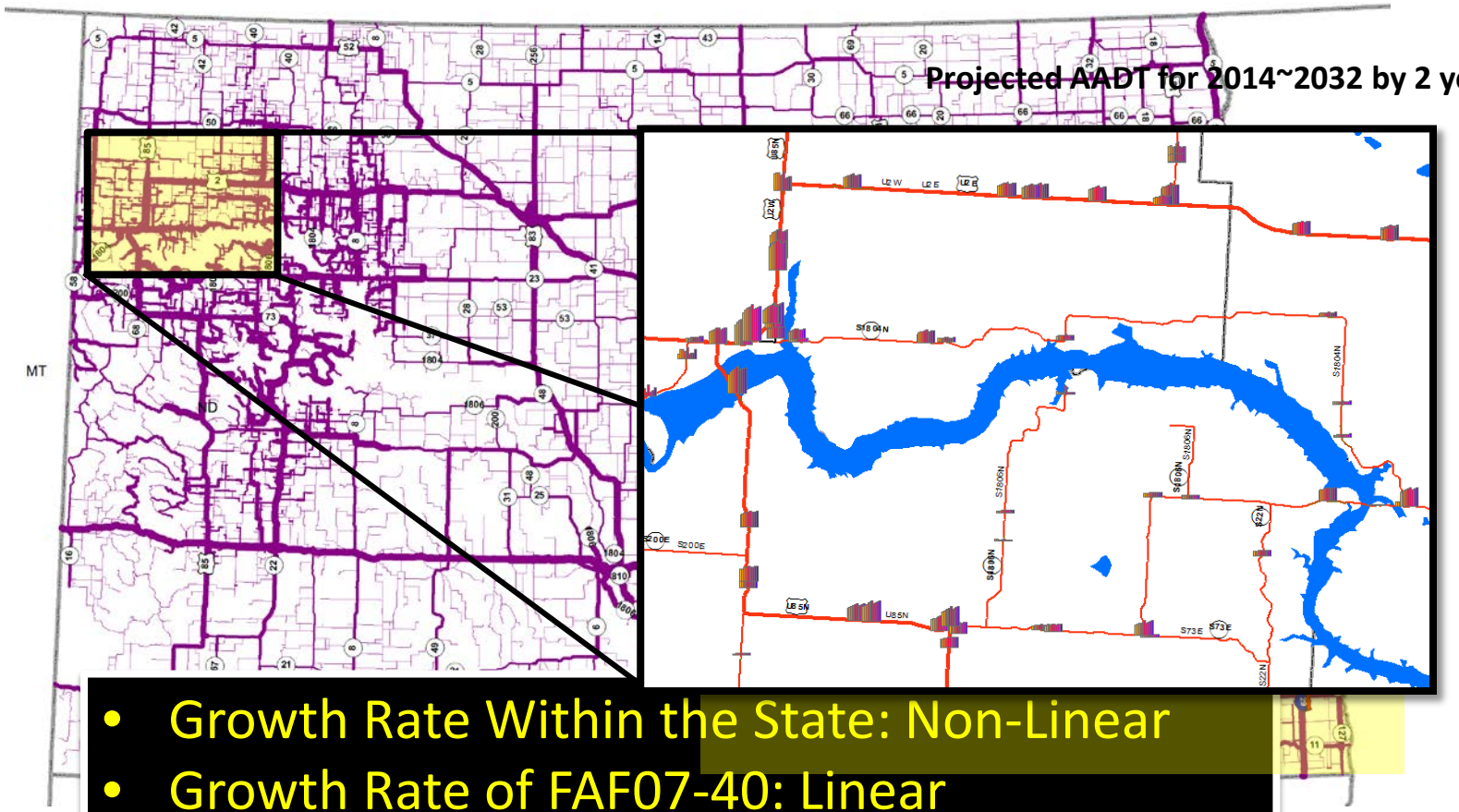


Hybrid

- Intra-zonal traffic & Inter-zonal Traffic



Hybrid



- Growth Rate Within the State: Non-Linear
- Growth Rate of FAF07-40: Linear

Results

Investment Needs for the Funding Periods

Table C: Summary of All Road Investment and Maintenance Needs for Counties and Townships in North Dakota (Millions of 2012 Dollars)

Period	Region		
	Oil Producing Counties	Rest of State	Statewide Total
2013-2014	$521	$311	$834
2015-2016	$389	$382	$772
2017-2018	$366	$397	$763
2019-2020	$321	$379	$700
2021-2022	$310	$336	$647
2023-2032	$1,576	$1,688	$3,264
2013-2032	$3,484	$3,495	$6,979

* Results may not sum due to rounding.

Decision Logic

Table 8: Decision Logic of Paved Road Model

Current PSR	Current Width Status	Required Overlay Thickness	Selected Improvement
< Reconstruction PSR	N/A	N/A	Reconstruct
≥ Reconstruction PSR	Deficient	< 3 inches	Resurface
≥ Reconstruction PSR	Deficient	≥ 3 inches	Resurface and widen
≥ Reconstruction PSR	Sufficient	N/A	Resurface

factors

- Average Daily Trips (ADT)
- Average Daily Truck Trips (ADTT)
- Truck Type and Axle Configuration
- Structural Number (SN)
- Cumulative ESALs
- Existing Pavement Structure
- Present Serviceability Rating (PSR)
- Oil Module (MR)
- Maximum Feasible Life with no truck traffic
- Graded Width

FAF

Source: www.ugpti.org

Results

Investment Needs for the Funding Periods

Table C: Summary of All Road Investment and Maintenance Needs for Counties and Townships in North Dakota (Millions of 2012 Dollars)

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* Results may not sum due to rounding.

By Funding Period and Road Type (millions of 2012 dollars)

Road Type	2013-2014	2015-2016	2013-2032
Unpaved	$471	$471	$5,033
Paved	$363	$301	$1,946
Total Statewide	$834	$772	$6,979

Source: www.ugpti.org

Results

Estimated Funding Required for the Funding Periods

By Funding Period and Road Type (millions of 2012 dollars)

Road Type	2013-2014	2015-2016	2013-2032
Unpaved	[illegible]	$471	$5,033
Paved	$363	[illegible]	$1,946
Total Statewide	$834	$772	[illegible]

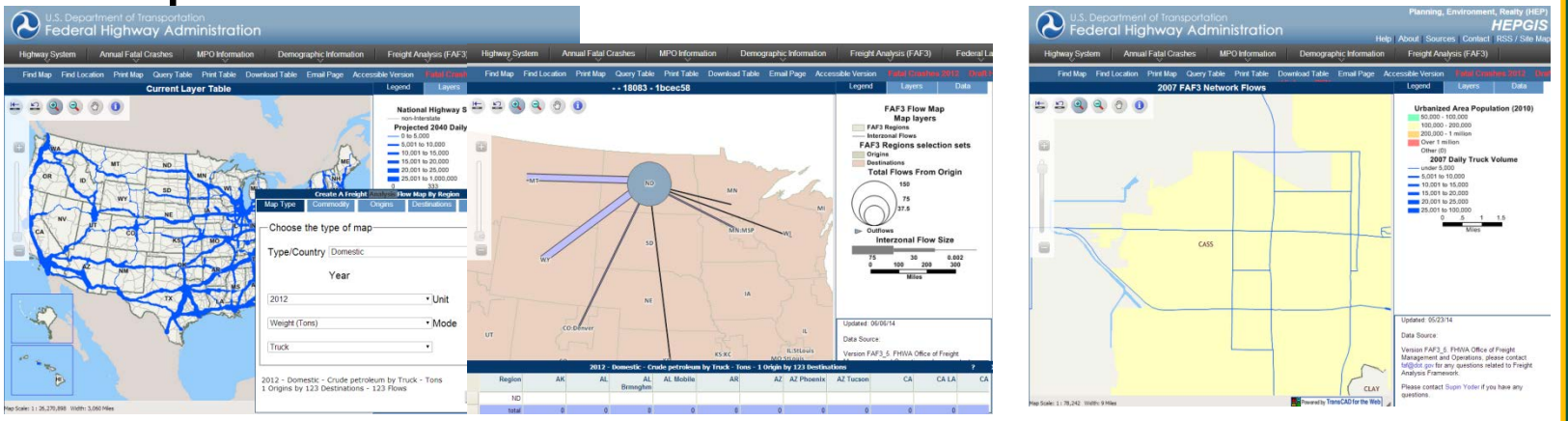
Table 10: Statewide Summary of Forecasted Improvements and Costs for Paved County and Township Roads

Period	Resurfacing		Widening		Reconstruction		Maintenance Cost ($000)	Total Cost ($000)
	Miles	Cost ($000)	Miles	Cost ($000)	Miles	Cost ($000)		
2013-2014	249	$76	135	$131	66	$98	$57	$363
2015-2016	497	$105	177	$114	17	$25	$57	$301
2017-2018	768	$160	96	$59	0	$0	$57	$277
2019-2020	734	$138	5	$3	0	$0	$57	$199
2021-2022	499	$88	0	$0	0	$0	$58	$146
2013-2022	**2,747**	**$567**	**413**	**$307**	**83**	**$123**	**$286**	**$1,286**
2023-2032	2,058	$351	0	$0	10	$14	$295	$660
2013-2032	**4,805**	**$918**	**414**	**$308**	**92**	**$138**	**$581**	**$1,946**

Source: www.ugpti.org

FAF & Road Investment Planning

- FAF outputs:
  - Yearly or biennial traffic flows
  - Directional flows for major highways and rural freight corridors
- Implication: road investments needed



Summary

- Demonstrated how FAF is used for Economic Analysis
- Demonstrated the process of combining local traffic and FAF traffic
- Discussed the components to improve for the future FAF

Thanks for your Attention!

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